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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/687,295	10/16/2003	Lyndon R. Logan	BUR920000195US2	9476

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EXAMINER

DOLAN, JENNIFER M

ART UNIT PAPER NUMBER

2813

DATE MAILED: 01/07/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/687,295

Applicant(s)

LOGAN ET AL.

Examiner

Jennifer M. Dolan

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 18-30 and 48-60 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 18-30 and 48-60 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 16 October 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>10/16/03</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 18, 19, 23, 24, 30, 48, 49, 53, 54, and 60 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,248,645 to Matsuoka et al.

Regarding claims 18 and 48, Matsuoka discloses a semiconductor device comprising: a P or N doped substrate (21) having a top surface (see column 3, lines 35-40; column 6, lines 45-60); a STI (30) having a bottom and first and second sidewalls (figures 2A-2F); a leakage stop implant (28) in the substrate under the STI and aligned to the second sidewall (figure 2C; implant uses sidewalls as a mask, thus causing the implant to be aligned to the sidewalls); and an N-well (or P-well for the N-substrate; 32a and b) adjacent to and in contact with the first sidewall, the n-well extending under the STI and forming an upper portion of an isolation junction with the leakage stop implant, the junction entirely under the STI (figures 2A-2F).

Regarding claims 19 and 49, Matsuoka further discloses a P-well (or N-well in the case or an N-substrate) adjacent to and in contact with the second sidewall, the well incorporated into the upper portion and forming a lower portion of the isolation junction (32a and 32b; see figures 2A-2F; column 6, lines 45-60).

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Regarding claims 23, 24, 53, and 54, Matsuoka discloses silicon nitride spacers (26) on the sidewalls of and contained in the STI (figures 2B-2F; column 6, lines 15-20).

Regarding claims 30 and 60, Matsuoka discloses a PFET in the N-well and an NFET in the P-well (figure 2F).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 21, 22, 51, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuoka et al.

Matsuoka discloses that the leakage stop implant comprises P or N-dopant (column 6, lines 46-60) with a specified dose and energy, and the concentration of the dopant at an interface formed by the bottom of the trench is high, such that the dopant outdiffusion in the wells is compensated (column 6, line 62 – column 7, line 5; also see column 4, lines 51-63). Matsuoka is considered to disclose a P or N dopant concentration of about $3E16 - 1E17 \text{ atm/cm}^3$ at the interface and about $1E17 - 1.5E17$ at about 0.1 micron below the interface, because the leakage implant dose and energy, as well as the layers implanted through, are not dissimilar to that disclosed by the applicant (see column 6, lines 46-62). Additionally, some of the dopant at the interface will diffuse into the trench liner material, such that the concentration at the interface is slightly smaller than that at 0.1 micron below the interface. Matsuoka is, however, silent as to

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the exact concentration at the interface. Assuming arguendo, Matsuoka does not have a P or N-dopant concentration of $3\text{E}16 - 1\text{E}17 \text{ atm/cm}^3$.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to specify that the P or N dopant concentration at the interface of Matsuoka is about $3\text{E}16 - 1\text{E}17 \text{ atm/cm}^3$. The rationale is as follows: One of ordinary skill in the art at the time the invention was made would have been motivated to specify an implant concentration such that that the leakage stop implant of Matsuoka fully compensates for dopant outdiffusion to the trench oxide lining and strengthens the junction against leakage and punchthrough. Although Matsuoka does not specify a P or N-dopant concentration, it has been held that "where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (1955). Thus, it is well within the purview of a person having ordinary skill in the art to specify a P or N-dopant concentration of about $3\text{E}16 - 1\text{E}17 \text{ atm/cm}^3$ through routine optimization of dopant implant doses and energies to provide leakage and punchthrough protection.

5. Claims 20 and 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuoka et al. in view of U.S. Patent No. 5,861,330 to Baker et al.

Matsuoka discloses that the leakage stop implant extends under the trench from the second sidewall toward the first sidewall a distance less than the width of the trench (figures 2C, 5C, 5D).

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Matsuoka fails to disclose that the distance of the implant is 10-40% of the width of the trench.

Baker discloses a leakage stop implant extending 10-40% of the width of the trench (2602; figure 18).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the width of the leakage stop implant of Matsuoka, so that it extends 10-40% of the width of the trench, as taught by Baker. The rationale is as follows: One of ordinary skill in the art at the time the invention was made would have been motivated to provide a leakage stop implant extending only 10-40% of the width of the trench, so that the P-well can be strengthened against leakage or punch through without the need to perturb the N-well profile by inserting the leakage implant ions in the N-well. Additionally, an implant spanning only 10-40% of the trench width allows for a second leakage stop implant, so that leakage between the P-well and P-source/drain regions can be prevented, as well as leakage between the N-well and N-source/drain regions (Baker, column 1, line 30 – column 2, line 8).

6. Claims 25-28 and 55-58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuoka et al. in view of U.S. Patent No. 6,342,429 to Puchner et al.

Regarding claims 25 and 55, Matsuoka merely discloses that the STI is filled with an oxide, but fails to teach that the oxide is a HDP oxide.

Puchner discloses that it is common and preferred for a STI to be filled with HDP oxide (column 4, lines 22-30).

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It would have been obvious to one of ordinary skill in the art at the time the invention was made to specify that the STI-filling oxide of Matsuoka is a HDP oxide, as suggested by Puchner. The rationale is as follows: A person having ordinary skill in the art would have been motivated to use a HDP oxide, because Puchner shows that it is commonly used in the art, has suitable properties for use as STI material, and has a well-defined deposition process, thus improving the ease of manufacture (see Puchner, column 4, lines 22-30).

Regarding claims 26-28 and 56 - 58, Matsuoka discloses a 10-30 nm thick thermal oxide liner (25; column 6, lines 10-15) on the bottom and sidewalls of the trench (figures 2A-2F), and spacers (26) on the liner over the first and second sidewalls and contained within the STI (figures 2A-2F).

7. Claims 29 and 59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsuoka et al. in view of U.S. Patent No. 6,069,057 to Wu.

Matsuoka fails to specify the dimensions of the STI.

Wu teaches a STI structure for separating adjacent NFETs and PFETs (figure 10), wherein the STI has a depth of 0.15-0.6 microns and a width of 0.05 microns to 10 microns (column 3, lines 40-55), which overlaps the range claimed by the applicant.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to specify that the STI of Matsuoka falls into the claimed ranges, as suggested by Wu. The rationale is as follows: A person having ordinary skill in the art would have been motivated to select dimensions of the STI falling into the claimed ranges, because Wu shows that such dimensions are suitable for fabrication of an STI as well as providing adequate isolation between adjacent NFETs and PFETs (Wu, column 3, lines 40-55). Since Matsuoka already suggests that

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the structure is an STI (see Matsuoka, column 1, lines 33-40; an STI is generally held to have a depth of less than 1 micron in order to be considered a "shallow trench") and that it is generally desirable to minimize the feature size for devices (column 1, lines 30-40), it is well within the purview of a person skilled in the art to select dimensions that are shown to be easily fabricated, sufficient for device isolation, and promoting the greatest possible degree of miniaturization.

Conclusion

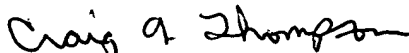
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Dolan whose telephone number is (571) 272-1690. The examiner can normally be reached on Monday-Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead, Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jennifer M. Dolan
Examiner
Art Unit 2813

jmd


CRAIG A. THOMPSON
PRIMARY EXAMINER